

US EPA ARCHIVE DOCUMENT

TABLE C-1-2
COPC INTAKE FROM PRODUCE

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Description

This equation calculates the daily intake of COPC from ingestion of exposed aboveground, protected aboveground, and belowground produce. The consumption rate varies for children and adults, and for the type of produce. The concentration in exposed aboveground, protected aboveground, and belowground produce will also vary with each scenario location.

Consumption rates were derived from the *Exposure Factors Handbook* (U.S. EPA 1997). U.S. EPA (1997) presents consumption rates based on body weight; therefore, body weight is not included as a variable in the calculation of I_{ag} .

Uncertainties associated with this equation include the following:

- (1) The amount of produce intake is assumed to be constant and representative of the exposed population. This assumption may under- or overestimate I_{ag} .
- (2) The standard assumptions regarding period exposed may not be representative of any actual exposure situation. This assumption may under- or overestimate I_{ag} .

Equation

$$I_{ag} = [(Pd + Pv + Pr) \cdot CR_{ag}] + (Pr \cdot CR_{pp}) + (Pr_{bg} \cdot CR_{bg}) \cdot F_{ag}$$

Variable	Description	Units	Value
I_{ag}	Daily intake of COPC from produce	mg/kg-day DW	
Pd	Aboveground exposed produce concentration due to direct (wet and dry) deposition onto plant surfaces	mg/kg	<p style="text-align: center;">Varies</p> <p>This variable is COPC- and site-specific, and is calculated by using the equation in Table B-2-7.</p> <p>Uncertainties associated with this variable include the following:</p> <ol style="list-style-type: none"> (1) The calculation of kp values does not consider chemical degradation processes. Inclusion of chemical degradation processes would decrease the amount of time that a chemical remains on plant surfaces (half-time) and thereby may increase kp values. Pd decreases with increased kp values. Reduction of half-time from the assumed 14 days to 2.8 days, for example, would decrease Pd about five-fold. (2) The calculation of other parameter values (for example, Fw and Rp) is based directly or indirectly on studies of vegetation other than aboveground produce (primarily grasses). Uncertainty is introduced to the extent that the calculated parameter values do not accurately represent aboveground produce-specific values.

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Variable	Description	Units	Value
P_v	Aboveground exposed produce concentration due to air-to-plant transfer	mg/kg	<p>Varies</p> <p>This variable is COPC- and site-specific, and is calculated by using the equation in Table B-2-8.</p> <p>Uncertainties associated with this variable include the following:</p> <ol style="list-style-type: none"> (1) The range of values for the variable B_v (air-to-plant biotransfer factor) is about 19 orders of magnitude for organic COPCs. (2) The algorithm used to calculate values for the variable F_v assumes a default value for the parameter S_T (Whitby's average surface area of particulates [aerosols]) of background plus local sources rather than an S_T value for urban sources. If a specific site is located in an urban area, the use of the latter S_T value may be more appropriate. The S_T value for urban sources is about one order of magnitude greater than that for background plus local sources and would result in a lower F_v value; however, the F_v value is likely to be only a few percent lower.
P_r	Aboveground exposed and protected produce concentration due to root uptake	mg/kg	<p>Varies</p> <p>This variable is COPC- and site-specific, and is calculated by using the equation in Table B-2-9.</p> <p>Uncertainty associated with this variable include the following:</p> <p>Estimated COPC-specific soil-to-plant bioconcentration factors (Br) may not be representative of site-specific conditions.</p>
$P_{r_{bg}}$	Belowground produce concentration due to root uptake	mg/kg	<p>Varies</p> <p>This variable is COPC- and site-specific, and is calculated by using the equation in Table B-2-10.</p> <p>Uncertainty associated with this variable include the following:</p> <p>Estimated COPC-specific soil-to-plant bioconcentration factors (Br) may not be representative of site-specific conditions.</p>

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Variable	Description	Units	Value																		
CR_{ag} , CR_{pp} , CR_{bg}	Consumption rate of aboveground, protected aboveground, and belowground produce, respectively	kg/kg-day DW	<p>This variable is site-specific. The recommended default values represent the total of the following produce-specific ingestion rates:</p> <table><thead><tr><th><u>Plant Type</u></th><th><u>Receptor</u></th><th><u>Ingestion Rate</u> <u>(kg/kg-day DW)</u></th></tr></thead><tbody><tr><td rowspan="2">Exposed Aboveground Produce (Cr_{ag})</td><td>Adult</td><td>0.0003</td></tr><tr><td>Child</td><td>0.00042</td></tr><tr><td rowspan="2">Protected Aboveground Produce (Cr_{pp})</td><td>Adult</td><td>0.00057</td></tr><tr><td>Child</td><td>0.00077</td></tr><tr><td rowspan="2">Belowground Produce (Cr_{bg})</td><td>Adult</td><td>0.00014</td></tr><tr><td>Child</td><td>0.00022</td></tr></tbody></table> <p>Ingestion rates were derived from U.S. EPA (1997), Tables 13-61 and 13-65. The ingestion rates listed in U.S. EPA (1997) are derived from the 1987-1988 USDA National Food Consumption Survey and may be used to assess exposure to contaminants in foods grown, raised, or caught at a specific site. The ingestion rates were adjusted for cooking and preparation loss as recommended by U.S. EPA (1997). The average preparation and cooking loss used for exposed vegetables was 15.8 percent (U.S. EPA 1997). However, it is assumed that no preparation and cooking loss occurs with exposed fruits because it is further assumed the fruit is eaten in the raw form. In addition, ingestion rates for the child receptor represent a time-weighted mean from the respective tables.</p> <p>Uncertainty associated with this variable include the following:</p> <p>The recommended ingestion rates are based on national average home produced consumption rates. Site-specific ingestion rates may be higher or lower than those recommended. Therefore, use of the recommended ingestion rates may under- or overestimate I_{ag}.</p>	<u>Plant Type</u>	<u>Receptor</u>	<u>Ingestion Rate</u> <u>(kg/kg-day DW)</u>	Exposed Aboveground Produce (Cr_{ag})	Adult	0.0003	Child	0.00042	Protected Aboveground Produce (Cr_{pp})	Adult	0.00057	Child	0.00077	Belowground Produce (Cr_{bg})	Adult	0.00014	Child	0.00022
<u>Plant Type</u>	<u>Receptor</u>	<u>Ingestion Rate</u> <u>(kg/kg-day DW)</u>																			
Exposed Aboveground Produce (Cr_{ag})	Adult	0.0003																			
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Belowground Produce (Cr_{bg})	Adult	0.00014																			
	Child	0.00022																			

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Variable	Description	Units	Value														
F_{ag}	Fraction of produce that is contaminated	unitless	<p>Varies</p> <p>This variable is site-specific. U.S. EPA OSW recommends the following default values in the absence of site-specific information, consistent with U.S. EPA (1994). The fraction of produce that is contaminated varies for each exposure scenario:</p> <table><tr><td><u>Exposure Scenario</u></td><td>F_{ag}</td></tr><tr><td>Adult Resident</td><td>0.25</td></tr><tr><td>Child Resident</td><td>0.25</td></tr><tr><td>Subsistence Farmer</td><td>1.0</td></tr><tr><td>Subsistence Farmer Child</td><td>1.0</td></tr><tr><td>Subsistence Fisher</td><td>0.25</td></tr><tr><td>Subsistence Fisher Child</td><td>0.25</td></tr></table> <p>U.S. EPA (1994) cites U.S. EPA (1990) as the reference source for the F_{ag} value for the adult resident, child resident, subsistence fisher, and subsistence fisher child. U.S. EPA (1994) does not provide a reference for the F_{ag} value for the subsistence farmer and the subsistence farmer child.</p> <p>The following uncertainty is associated with this variable:</p> <p>Fraction of produce that is contaminated will vary from site to site. Use of default values may overestimate or underestimate F_{ag}.</p>	<u>Exposure Scenario</u>	F_{ag}	Adult Resident	0.25	Child Resident	0.25	Subsistence Farmer	1.0	Subsistence Farmer Child	1.0	Subsistence Fisher	0.25	Subsistence Fisher Child	0.25
<u>Exposure Scenario</u>	F_{ag}																
Adult Resident	0.25																
Child Resident	0.25																
Subsistence Farmer	1.0																
Subsistence Farmer Child	1.0																
Subsistence Fisher	0.25																
Subsistence Fisher Child	0.25																

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REFERENCES AND DISCUSSION

Baes, C.F., R.D. Sharp, A.L. Sjoreen, and R.W. Shor. 1984. *Review and Analysis of Parameters and Assessing Transport of Environmentally Released Radionuclides through Agriculture*. Oak Ridge National Laboratory. Oak Ridge, Tennessee.

This document is cited as a source for Br values.

U.S. EPA 1990. *Exposure Factors Handbook*. Office of Health and Environmental Assessment, Exposure Assessment Group. Washington, D.C. March.

This is the document cited as the source of the fraction of produce that is contaminated (F_{ag}) the adult resident, child resident, and subsistence fisher. U.S. EPA assumes that F_{ag} for the subsistence fisher child is the same as for the subsistence fisher.

U.S. EPA 1992. *Technical Support Document for Land Application of Sewage Sludge*. Volumes I and II. Office of Water. Washington, D.C. EPA 822/R-93-001a.

This document is cited as a source for plant uptake response slope factors.

U.S. EPA. 1994. *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Waste*. Office of Emergency and Remedial Response. Office of Solid Waste.

This document is cited as the source of the fraction of produce that is contaminated (F_{ag}) for the subsistence farmer (U.S. EPA assumes that F_{ag} for the subsistence farmer child is the same as for the subsistence farmer).

U.S. EPA. 1997. *Exposure Factors Handbook*. Office of Research and Development. EPA/600/P-95/002F. August.

This document is the source for produce consumption rates.